Innovation and Aging – Toward a Bi-directional perspective

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I. Introduction

Aging is among the most striking societal changes that highly industrialized economies face. While a number of related challenges, such as the increasing pressure on social security systems, are being widely addressed by policy makers, the consequences of demographic changes for innovation systems and processes have surprisingly not been a major research topic. The implications and challenges of demographic changes for innovation remain a puzzle for public policy-makers, managers and civil society alike: While aging calls for innovative solutions to help solving some of the societal problems associated with demographic changes, it still remains unclear, whether aging societies may prove to stay as innovative as today. To be able to provide innovative solutions, companies have to understand changing demand and consumption patterns in aging societies in order to remain competitive. And policy makers have to foster conditions under which innovators can meet the demands of an aging society. This is crucial for both, companies in order to remain competitive, and societies in order to improve the facilitation of individual aging.

This paper focuses on a bias in current conceptualizations of the relationship between technology and aging. As I shall demonstrate below, this bias can be expected to constrain policy making targeted at tackling future challenges of innovation in aging societies. In current models of how new technology should be developed to address challenges associated with aging societies, the aging user or consumer is normally seen as a mere recipient of new technology. New products and services addressing should compensate for physical shortcomings associated with individual aging; available products and services should be adjusted in such a way that they become usable despite of such shortcomings. This is an important perspective; however, it falls short in addressing the whole range of issues at stake for innovators when more and more of their customers reach the age of retirement. In this context, the present paper argues for a symmetrical, bi-directional perspective on the relationship between technology and aging. This perspective does not reproduce the cliché of the passive and powerless user, but focuses on the user as an active participant in the innovation process. In other words, a bi-directional perspective takes aging users serious as consumers in the full sense. Indeed, aging populations will not only shape the future of innovation as recipients of assistive technologies, but they will leave their mark on future products and service simply through their multitude and purchasing power. The bi-directional perspective introduced below brings into sight the full-blown set of implications of aging for innovation, and thus makes them accessible for policy makers and innovators alike.

The paper is organized as follows. In Section 2, I flesh out a dominant model that underlies current thinking about the relationship between technology and aging. I further demonstrate that this model implies a number of misconceptions; these misconceptions are grounded in more fundamental conceptual simplifications. I discuss these simplifications in the light of standard knowledge in the science and technology studies (STS) about the role of users in innovation processes. A complementary model is then introduced that completes the current thinking with the whole range of roles elderly users may have in innovation processes. In Section 3, finally, I flesh out management and policy implications of the new model.

II. Towards a Bi-directional Model

This section summarizes a particular area of research that investigates how technology, i.e. newly developed technical objects and technology-based services, affect aging. It is the purpose of this section to point out a number of issues that challenge our understanding of the innovation process in general. The overall thread of the research area labeled Gerontechnology or Gerotechnology [1] is to explore the impact of technology on the quality of older adults' lives and the process of individual aging. Wahl and Mollenkopf [2] have provided an overview of different approaches within the field of Gerontechnology. They argue that at the general level all these approaches conceptualize technology and human development (aging) as an interactional relationship "placing the person and his or her environment (including technological devices) in a dynamic and reciprocal interchange system" (p. 234). At the heart of this approach are thus person-environment dynamics.

However, there are many ways to operationalize this perspective, and, indeed, many such ways have been elaborated, usually from the perspectives of single disciplines. Particularly widespread, as Wahl and Mollenkopf show, are micro-perspectives in the realm of basic research, i.e. "research based on human factors models" and "research based on information processing models" (p. 235). These approaches have in common the fact that they "place strong emphasis on the role of age-related decrements in perception, attention, memory, and (fluid) intelligence" (p. 234). They focus on "normal" aging, i.e. individual aging without chronic conditions and diseases. However, "normal" aging is modeled as a decline of competences that has to be compensated for. And this is exactly the role technology can have vis-à-vis individual aging – to compensate for age related deficits and shortcomings. Wheelchairs, hearing aids, walking frames and the like are good examples for such assistive technologies [cf. 3].

An instance of the micro-perspective is the human factors approach. The basic model underlying this approach centers on the demands of a technological system (hardware interface, software interface, instructional support) vis-à-vis the capacities of individual operators or users (perceptual, cognitive, psychomotor). "The degree of fit between the demands of the system and the capabilities of the user will determine performance on the system as well as attitudes, acceptance, usage of the system, and self-efficacy beliefs about one's own capabilities to use the system." [4: 2]. If there is a misfit between the demands of a system and the capacities of a user, errors are likely to occur during operations, and the usability of the system is not optimal. Especially, task analytical approaches have produced a wealth of data showing that even the most common everyday products pose severe usability problems. Against this background, the human factors approach is an important design factor that will help to anticipate errors and influence design and instructional support to prevent such errors.

From a sociological perspective, however, the human factors approach is not without difficulties due to a number of underlying assumptions about the relationship between technical objects and human actors:

(i) The model assumes that there is a "correct" usage of a technological system. Deviations from this use result in error. However, as is well established in STS [5, 6, 7], there are always many ways to use an artifact and this may lead to numerous redefinitions of the "correct" use during use. Indeed, artifacts contain a script for a "correct" use, but that script is often renegotiated and adapted in real use [6, 7]. In other words, while there might be a prescribed use for most artifacts, real use often deviates from the prescribed use. Against this background, the notion of a correct use of an artifact seems to be somewhat simplistic.

(ii) The model defines usability as a fit between engineers' conceptions of use and the users' actual use. In this sense, it measures the quality of an artifact in terms of how well it enforces compliance with the script it contains. Again, this seems to be a somewhat limited perspective that neglects the many uses human actors may invent with regard to an artifact. In fact, numerous commonplace technologies, such as the telephone or the radio, would not have come into existence without creative deviations from engineers' conceptions of use. In particular, Silverstone et al. [8] have established that artifact go through a lengthy process of being "tamed" or "domesticated" by users. It is important to take these forms of identity building during the process of domestication into account, when different versions of a new artifact pass through subsequent instances of being put into use.

(iii) Finally, the model carries somewhat static notions of demand and capacities, thereby ignoring learning that takes place while demand and capacities are aligned in interaction of the system with the user. Again, one should not neglect that users build up capacities with regard to a system while they try to fulfill or alter the demands posed on them by this system. Hence, both the capacities of users and the demands of a system change when intended uses are altered and realized over time.

These limitations are likely to play out differently depending on whether one is *compelled* to use a certain artifact, or one *wants* to use a certain artifact. Indeed, as Wahl and Mollenkopf [2] have pointed out, there are important differences between everyday technology, i.e. products and services that populate our homes, such as classic household technology and a wide range of information and communication technologies, and assistive technology. According to these authors, the former calls the deficit model into question and asks for a more balanced view focusing on over- as well as underdemands of technology (p. 235). In other words, technical objects in the private home may as well provide stimuli for learning precisely because they are challenging to use.[1] It is the domestication of artifacts into one's life (and the learning that comes with it) that may improve individual aging as much as overdemand may frustrate it.

This goes back to the classic idea of successful aging [11, 12], which, in a nutshell, points out that individual aging is not a solely biologically determined process but a process that can be influenced. In fact, biological aging in the form of cognitive and physical decline becomes predominant only beyond the age of 80 (the so-called fourth age). As a consequence, individual aging is not only a process of developing shortcomings and deficits, but also a process in which competences and skills simply change.

On a similar note, Lawton [13] has discussed the relationship between technology and aging along two dimensions. First, there may be an "individual lag" that opens up between the demands posed on an individual by the technical objects that surround him or her. Individual lag causes frustration and negative feelings, and is affected by cognitive decrements and shortcomings that come with individual aging. Secondly, there may be a "socio-structural lag" that opens up between the needs of an individual and the opportunities to fulfill these needs offered by the artifacts surrounding it. Socio-structural lag does not immediately cause negative emotions, but rather suppresses the development of positive emotions. It is, therefore, less obvious than individual lag, and has, indeed, often been neglected in gerontechnological research. Combining the dimensions of individual and socio-structural lag, Lawton

[1] Elsewhere, we have labeled such a perspective the *salutogenetical* approach towards senior appropriate technology [9, 10].

summarizes a more complete view on the relationship between individual aging and technology:[2]

> *"If we can decrease individual lag we can increase function and thereby decrease negative emotional states. If we can decrease social-structural lag we can increase fun and personally fulfilling activities and thereby increase positive emotional states." [13: 13]*

Hence, the development of new products and services for aging users has to take into account both learning that is stimulated by "domesticating" technical objects and decrements that can be compensated for by technical objects. Most importantly, the "demands" of a technology must not only meet the capacities of older people, but the technological environment must provide sufficient learning stimuli for the "right" capacities to develop. This approach highlights the process through which the capacities of users and the demands of a technology are aligned, both in terms of new capacities and adjusted demands. Additionally, the approach does not take "demand" as given but sees it rather as a flexible dimension to the various contexts of use in which a technology is "domesticated".

Against this background, Fig. 1 illustrates two stylized types of technical objects and their implications for the relationship between technology and aging. On both sides, technical objects and their use provide learning opportunities and contribute to identity building. They do so, however, in markedly different ways. The predominant view is depicted on the right side where assistive technologies are defined as technical objects that one has to use, i.e. in contexts where one needs to compensate for age related decrements. Health care products and services that have an "out of home" component, i.e. that are dependent on maintenance or operation by service providers, are the main area of application. Here, the human factors or usability approach is most relevant, because correct usage and easy accessibility are, indeed, of primary importance. Failing to ensure usability and correct use may result in frustration and negative emotions. Thinking about new products is based on individual lag theory, i.e. age related deficits are the basis for specifying new product characteristics. Public service providers are likely to play an important role, and, therefore, suppliers of assistive technologies have to deal with clients rather than the end users themselves. Technical objects are part of the social structure elderly people are confronted with, and this structure provides only little room for agency.

[2] Lawton was heavily influenced by Riley's notions of individual and structural lag. Her work is based on a sociological understanding of the aging process where human development is determined by the roles society offers us over our life span. It is beyond the scope of this paper to discuss Riley's influential work, which runs up against limits of its own. A good overview, however, is provided in Riley and Riley [14] as well as Dannefer et al. [15].

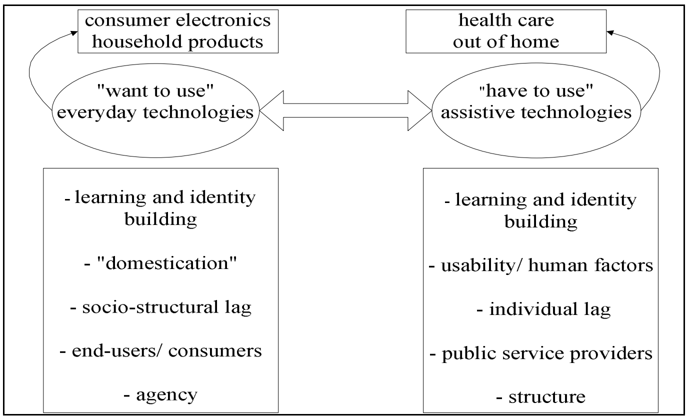

Fig. 1. Technology and aging – a bi-directional perspective

On the left side, an alternative perspective is portrayed which is not fully addressed in the gerontechnological literature. Here, everyday technologies are defined as those technical objects one wants to use, and classical household products as well as new and old consumer electronics are good examples [2]. For such products or services it is the process of creative use and domestication which is the basis for learning and identity building rather than "correct" use and easy accessibility. It is the ways through which elderly people integrate an unknown technical object into their daily life that defines this object's effect on individual aging. Hence, thinking about new products should be based on socio-structural lag theory, i.e. the needs elderly people have vis-à-vis technical objects which contribute to personal fulfillment. Suppliers of everyday technology are likely to deal with end users directly, i.e. public service providers can be expected to play a minor role with regard to everyday technology. Technical objects open up room for agency through which elderly people manipulate the social structure in which individual aging takes place.

These types of technical objects constitute extremes on a continuum that represent two complementary views on how technology and individual aging are related. These extremes indicate a possible range of knowledge that can be exploited in new product development and that pose a range of challenges with respect to the representation of users and use in innovation projects. In the following section, I briefly discuss a number of policy implications the follow from the new perspective on technology and aging.

III. POLICY IMPLICATIONS

Technological change and demographic aging have long been identified as two "megatrends" that shape the future of industrialized economies. However, this relationship has received biased attention so far, focusing primarily on age related decrements and how they can be mitigated by means of new products and services. Since recently, this is change as more and more companies, particularly in the consumer goods industries, start to realize that markets of the future will considerably been shaped by elderly consumers. Furthermore, policy makers are increasingly interested in technological solutions to problems associated with demographic aging. Unfortunately, scholars of innovation, a natural resource policy makers and innovators turn to for advice, have relatively little to say about these challenges, let alone provide appropriate answers to them. The model proposed here strives to make a first step towards closing this gap and brings into sight the full set of issues at play when innovators address an aging marketplace. Two important contributions to current thinking may be especially relevant for policy makers and innovators:

(i) The bi-directional model fosters thinking about the consequences of aging for the whole range of technologies present in private homes. Hence, it proposes to think of Gerontechnology not only in terms of a limited set of technologies, usually associated with the care sectors, but take the whole set of industrial sectors into account that are more generally associated with consumer goods. While current thinking about Gerontechnology is appropriate and indeed highly needed to tackle challenges in the care sector, where it is important that users follow generally agreed upon scripts, it is also likely to limit the answers policy makers will develop to come to grips with the challenges of demographic aging in other sectors. Many technologies, particularly in the realm of consumer electronics, strive on a playful attitude of their users and tolerate a considerable range of possible uses. Most likely, elderly customers will be able to use this flexibility and thus, at least partially, the future of consumption in consumer goods industries. To understand the peculiar forms of domestication and the learning that arises from them may thus well be the most important challenge for future innovators in these sectors.

(ii) The bi-directional model opens up new paths for empirical research on the relationship between technology and individual aging. Especially, such research will provide innovators with the tools and concepts to address changing consumption patterns, and thus gain competitive advantage in aging societies. The lifestyle of the elderly is changing – seniors of tomorrow will not be the same as those of today or yesterday. For innovators, it is important to understand these changing patterns of aging, which will translate into changing patterns of demand and consumption. One trend seems to be especially pertinent in this respect – among those currently reaching the age of retirement, a solid share does enjoy relatively good health, is economically well-off and open to new technology. It is thus important to go beyond the one-sided perception of elderly users as mere recipients of assistive technologies, and acknowledge their potential as “premium” customers. The model proposed here will provide innovation managers with tools and concepts to appreciate this and understand better how their products and business models should be modified in order to appeal to this attractive generation of senior customers. Last but not least, this research will thus contribute to a new perception of the elderly consumer – not as somebody in need of assistance by technology, but as a lead user whose consumption pattern will be ahead of market trends [16]. Results of research based on the bi-directional model will thus break the ground for a more comprehensive understanding of how aging consumers change the way technology permeates our private lives.

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